
Development and Evolution of the Human Neocortex.

Journal:	Cell
Publication Year:	2011
Authors:	J H Lui, D V Hansen, A R Kriegstein
PubMed link:	21729779
Funding Grants:	Training Program in Stem Cell Research at UCSF

Public Summary:

Many of the extraordinary intellectual capabilities of humans are attributed to the proper development and function of the neocortex. This region of the brain is responsible for higher cognitive functions such as sensory perception, spatial reasoning, and conscious thought, and is distinguished in humans by its large size and extensively folded pattern. However, the developmental events that underlie this structure have mostly been inferred from characterizations of the mouse or rat, whose neocortex is small and not folded. In this review, we discuss evidence from direct observations of the developing human neocortex that could explain its extraordinary size, shape, and function upon full maturation. We discuss how the developing human neocortex is distinguished by having a region called the outer subventricular zone (OSVZ) that contains a huge number of dividing cells. In particular, this brain region contains a novel stem cell type called an oRG cell that divides multiple times before producing neurons. We believe that these cells serve critical functions to both expand neuron number and also guide them to their final destination. Upon comparisons with other species, we find that the OSVZ and oRG cells are not features specific to humans and primates. Instead, these features are widespread in many animals, but their abundance is highly correlated with species that have greater brain size and more complex folding. Because the OSVZ and oRG cells are intimately related to increasing the complexity of the brain, they may also be key sites of action in neurodevelopmental diseases such as autism and schizophrenia. Future work revealing the mechanisms of OSVZ biology will be critical towards understanding features of brain development and degeneration particularly relevant for humans.

Scientific Abstract:

The size and surface area of the mammalian brain are thought to be critical determinants of intellectual ability. Recent studies show that development of the gyrated human neocortex involves a lineage of neural stem and transit-amplifying cells that forms the outer subventricular zone (OSVZ), a proliferative region outside the ventricular epithelium. We discuss how proliferation of cells within the OSVZ expands the neocortex by increasing neuron number and modifying the trajectory of migrating neurons. Relating these features to other mammalian species and known molecular regulators of the mouse neocortex suggests how this developmental process could have emerged in evolution.

Source URL: <https://www.cirm.ca.gov/about-cirm/publications/development-and-evolution-human-neocortex>